

Long-term validation of satellite-derived AOD and the contribution of meteorological factors to its inter-decadal changes

Huizheng Che^{a,*}, Ke Gui^{a,b}, Xiangao Xia^{b,c}, Leiku Yang^d, Chao Liu^d, Yaqiang Wang^a, Brent N. Holben^e, Philippe Goloub^f, Emilio Cuevas-Agulló^g, Hong Wang^a, Yu Zheng^{a,h}, Hujia Zhao^a, and Xiaoye Zhang^a

^aState Key Laboratory of Severe Weather and Key Laboratory of Atmospheric Chemistry, Chinese Academy of Meteorological Sciences, CMA, Beijing, 100081, China

^bCollege of Earth and Planetary Sciences, University of Chinese Academy of Sciences, Beijing, 100049, China

^cKey Laboratory for Middle Atmosphere and Global Environment Observation (LAGEO), Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, 100029, China

^dSchool of Surveying and Land Information Engineering, Henan Polytechnic University, Jiaozuo 454000, Henan, China

^eNASA Goddard Space Flight Center, Greenbelt, MD, USA

^fLaboratoire d'Optique Atmosphérique, Université des Sciences et Technologies de Lille, 559655, Villeneuve d'Ascq, France

^gCentro de Investigación Atmosférica de Izaña, AEMET, 38001 Santa Cruz de Tenerife, Spain

^hCollaborative Innovation Center on Forecast and Evaluation of Meteorological Disasters, Nanjing University of Information Science & Technology, Nanjing 210044, China

*Presenting author (chehz@cma.gov.cn)

This study provided a comprehensive evaluation of the Moderate Resolution Imaging Spectroradiometer (MODIS) Collection 006 (C6) and 061 (C6.1) Dark Target (DT) 10 km aerosol optical depth (AOD) over China during 2002–2014. Considering that sparse Aerosol Robotic Network (AERONET) sites are available in China, 18 sites from China Aerosol Remote Sensing Network (CARSNET) were also used to conduct this validation. The results showed that C6.1 DT achieved a reduced RMSE of 0.171, a higher R of 0.901 and a bias closer to 0 relative to C6 (RMSE: 0.185; R: 0.890). When the validation was conducted over different underlying surfaces, C6 DT overestimated AOD by 19.8%, with only 45.01% of the retrievals within the EE over urban sites, whereas C6.1 showed clear improvements, with 11.8% more data falling within the EE. Hardly any improvement was observed in C6.1 over forest, cropland, and grassland sites. The C6.1 DT exhibited more significant improvements over Beijing area and northern China than southern China. In addition, a long-term (1980–2016) aerosol dataset from the Modern-Era Retrospective Analysis for Research and Applications, version 2 (MERRA-2) reanalysis, along with two satellite-based AOD datasets (MODIS/Terra and MISR) from 2001 to 2016 is used to investigate the long-term trends in global and regional aerosol loading. Statistical models based on emission factors and meteorological parameters were developed to identify the main factors driving the inter-decadal changes of regional AOD and to quantify their contribution. The statistical analyses suggested that the meteorological parameters explained a larger proportion of the AOD variability (20.4% – 72.8%) over almost all regions of interest (ROIs) during 1980–2014 when compared with emission factors (0% – 56%). Further analysis also showed that SO₂ was the dominant emission factor, explaining 12.7% – 32.6% of the variation in AOD over anthropo-

genic aerosol-dominant regions, while BC or OC was the leading factor over the biomass burning-dominant (BBD) regions, contributing 24.0% – 27.7% of the variation. Additionally, wind speed was found to be the leading meteorological parameter, explaining 11.8% – 30.3% of the variance over the mineral dust-dominant regions, while ambient humidity (including soil moisture and relative humidity) was the top meteorological parameter over the BBD regions, accounting for 11.7% – 35.5% of the variation. The results of this study indicate that the variation in meteorological parameters is a key factor in determining the inter-decadal change in regional AOD.

Preferred mode of presentation: Oral